

ATM

# INDRA ADS-B SYSTEM

AUTOMATIC DEPENDANT SURVEILLANCE – BROADCAST

JULY -2014



**indra**

# INDEX

- 01 ADS-B in Air Traffic Management
- 02 ADS-B Regulations and Mandates
- 03 Indra ADS-B: Highlights
- 04 Indra ADS-B: System Design.
- 05 Indra Experience

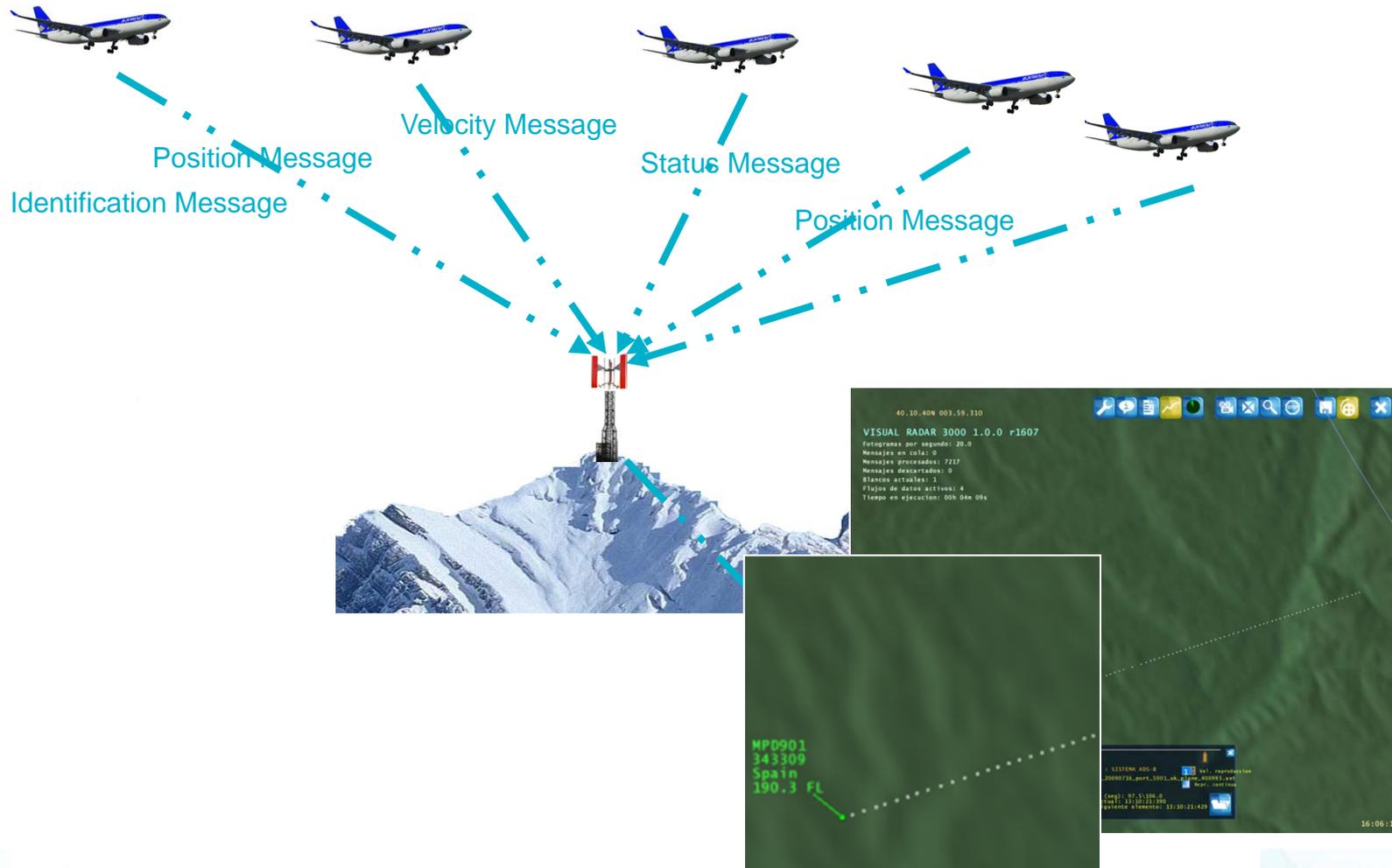
## DEFINITION

- **A**utomatic: Aircraft equipped with ADS-B transmit automatically information about **Identification, Position, Velocity Vector, Flight Status....**
- **D**ependant: Information depends on aircraft equipment capabilities.
- **S**urveillance: ADS-B provides surveillance over ADS-B equipped aircraft.
- **B**roadcast: Information is broadcast from the aircraft using 1090 MHz **Extended Squitter messages** in Mode S Down Format DF17.



# ADS-B IN AIR TRAFFIC MANAGEMENT

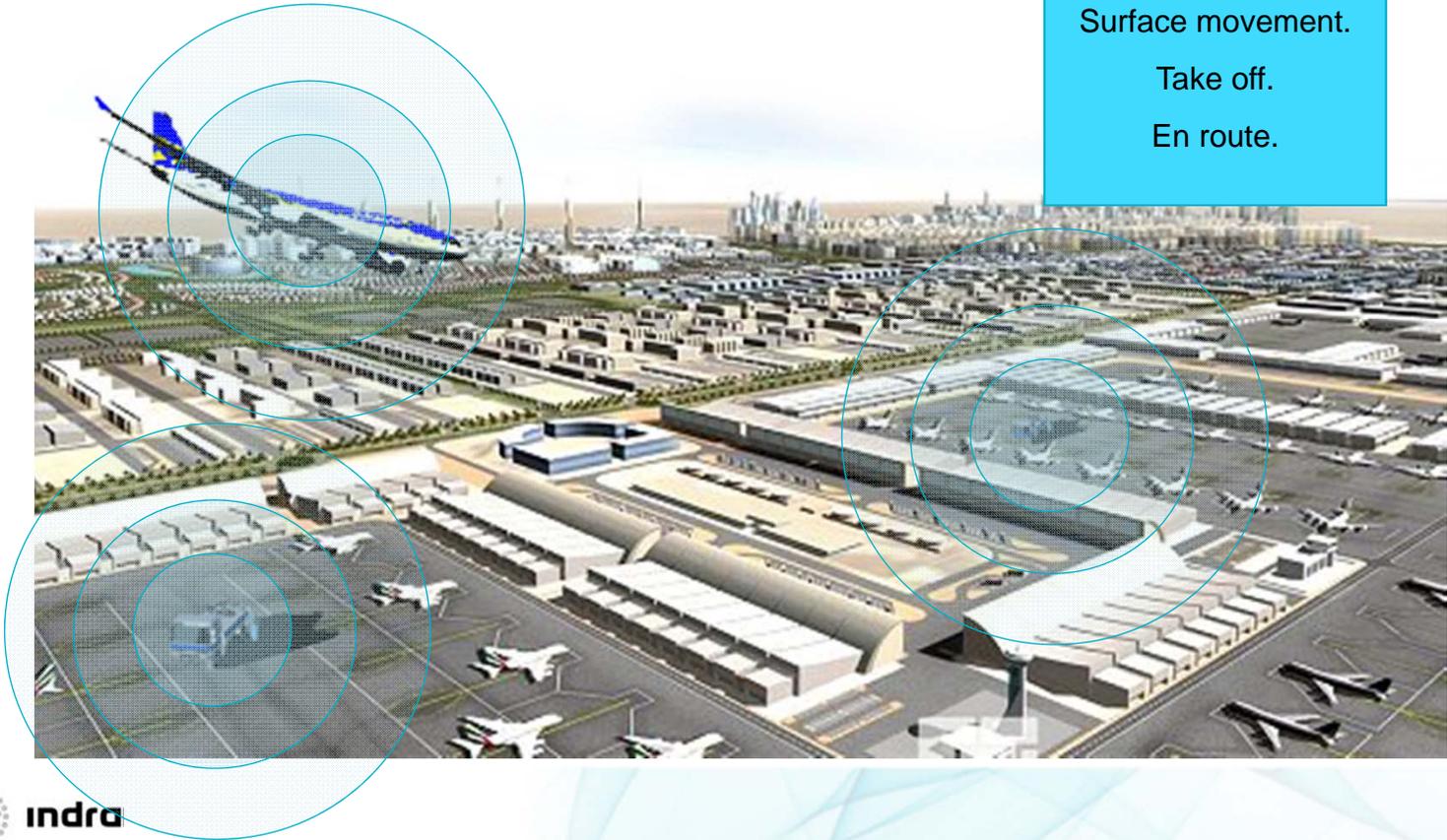
## INFORMATION USED



# ATM APPLICATIONS

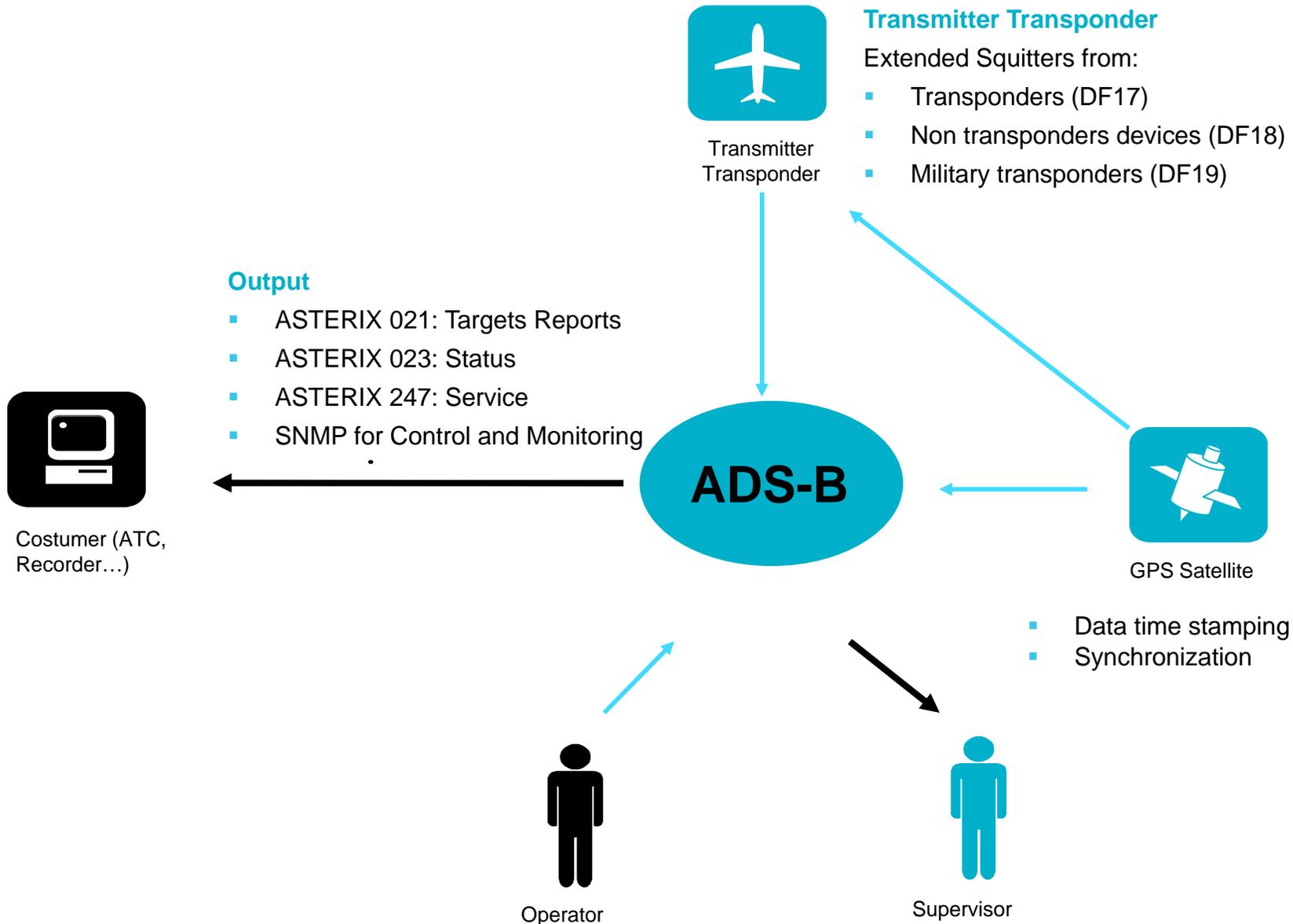


Approach.  
Landing.  
Surface movement.  
Take off.  
En route.



# ADS-B IN AIR TRAFFIC MANAGEMENT

## SYSTEM CONTEXT



## MAIN BENEFITS

**1. High data update rate:** Once per 0,5 seconds in ADSB-GSS equipment (Configurable).

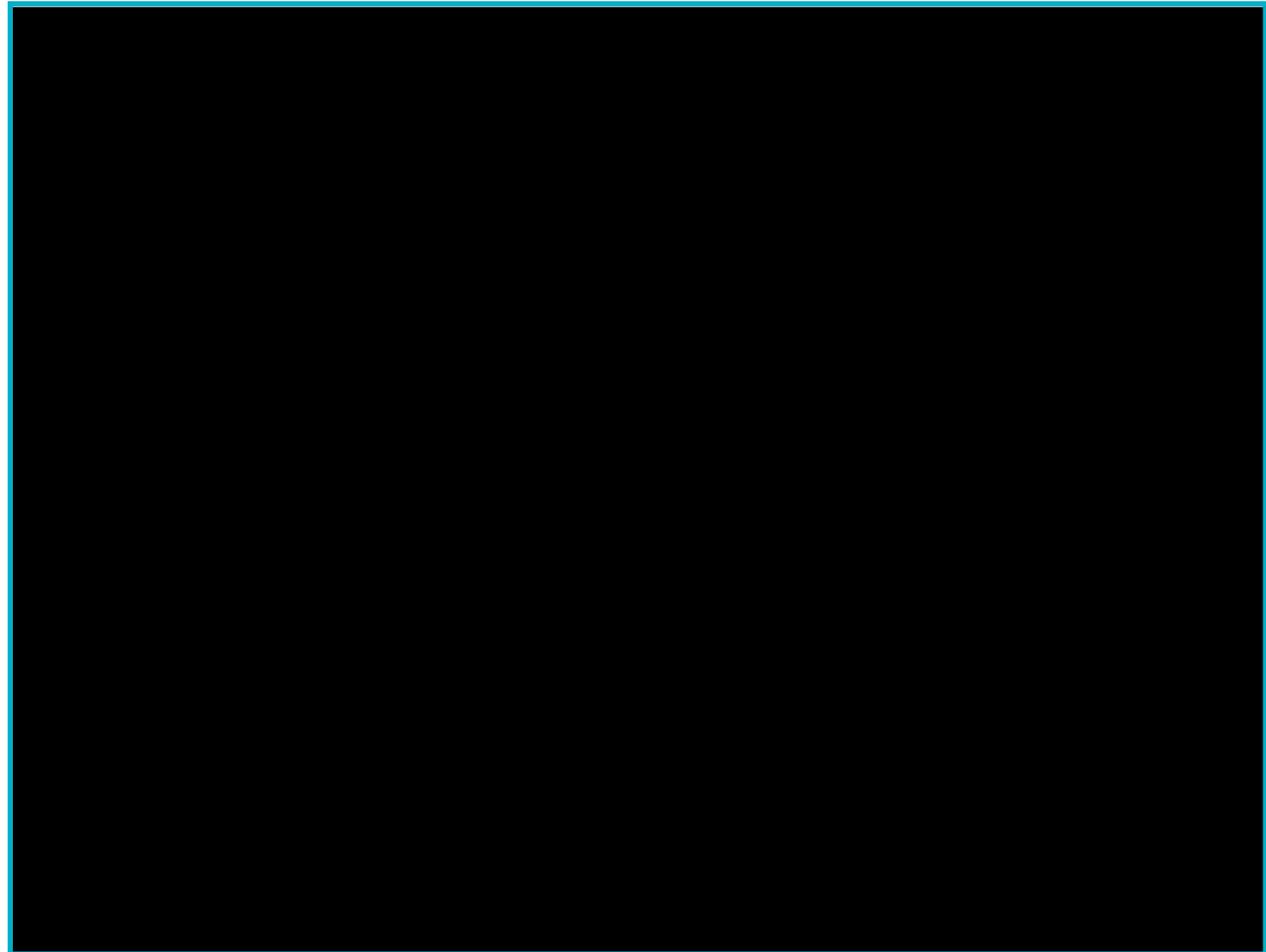
### 2. Accuracy:

Position reported by ADS-B is more accurate than current radar positions.

### 3. Lower Costs:

ADS-B reduces the costs of deployment & installation.

Operation & Maintenance costs also reduced (No rotating elements).



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01 ADS-B in Air Traffic Management

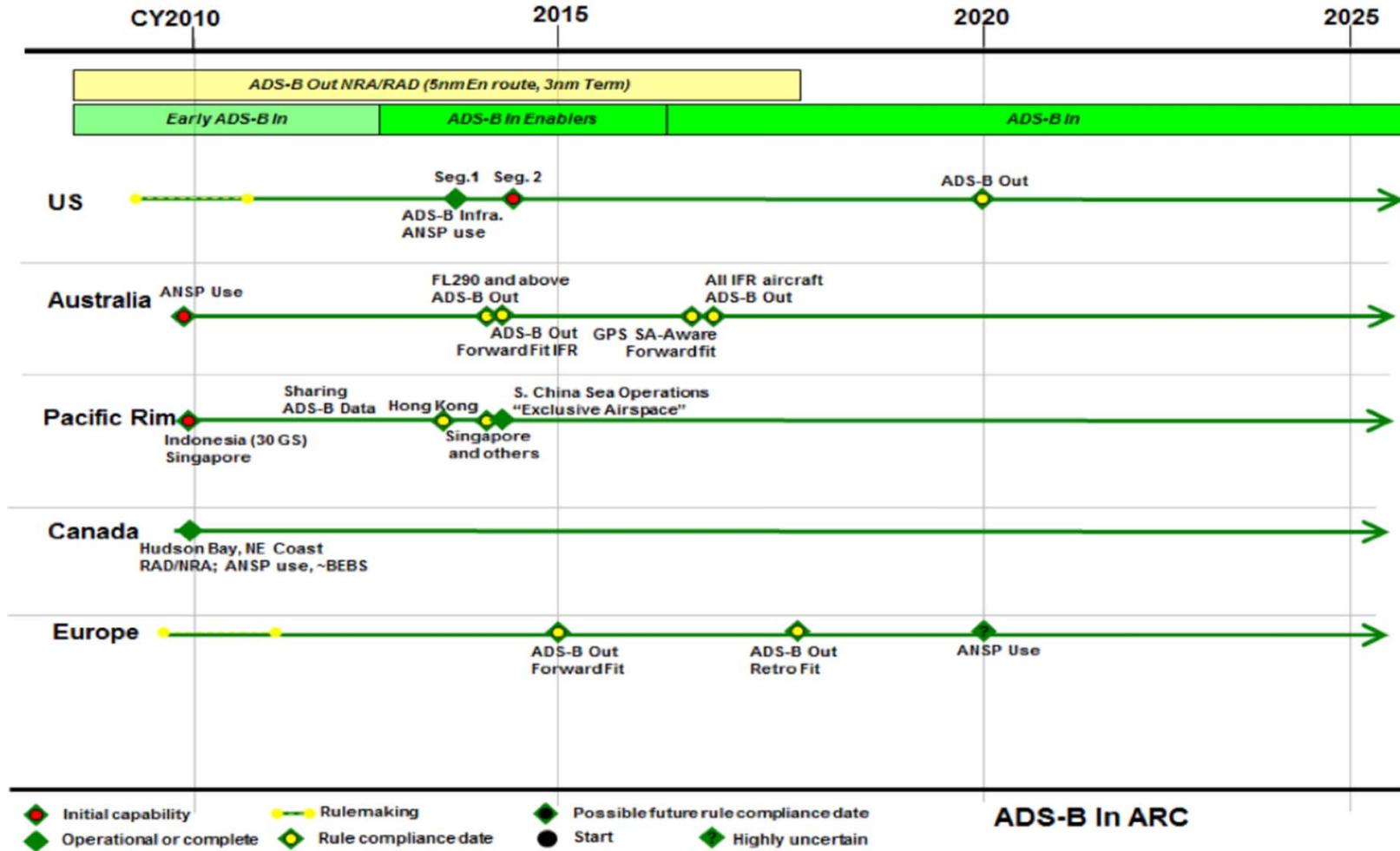
02 ADS-B Regulations and Mandates

03 Indra ADS-B: Highlights

04 Indra ADS-B: System Design.

05 Indra Experience

# ADS-B WORLD-WIDE REGULATIONS



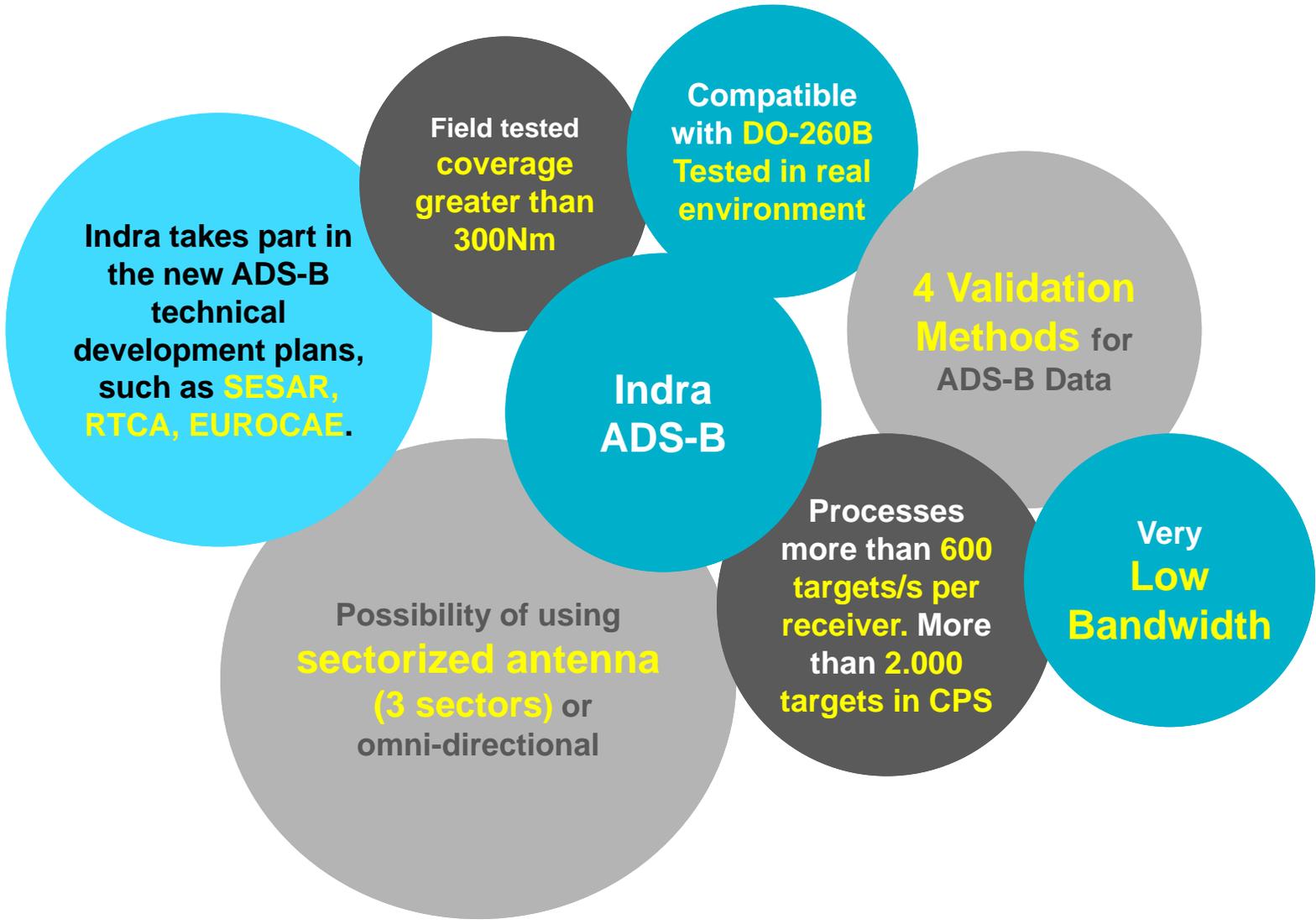
**U.S.A:** "By January 1, 2020 all aircraft operating on U.S. transponder airspace will be required to carry equipment that produces an ADS-B Broadcast."

**Australia:** "On and after 12 December 2013, any aircraft that is operated at or above FL 290 must carry ADS-B transmitting equipment..."

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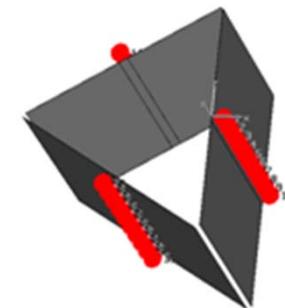
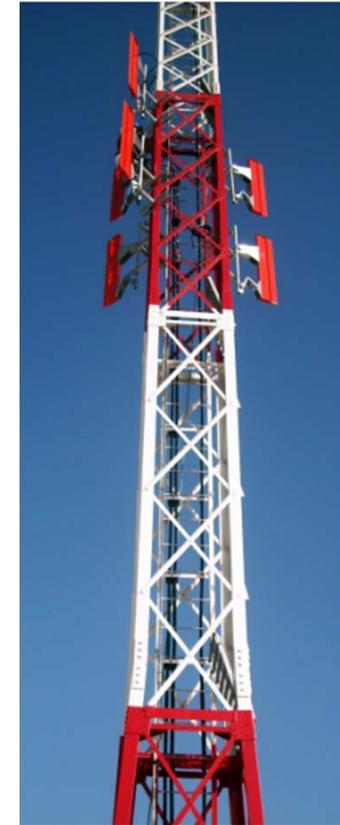
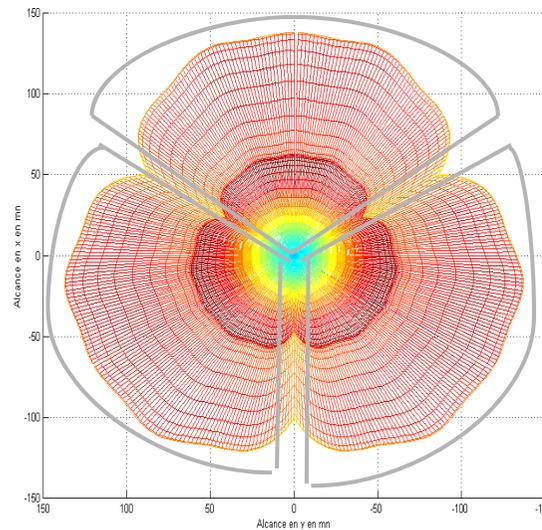
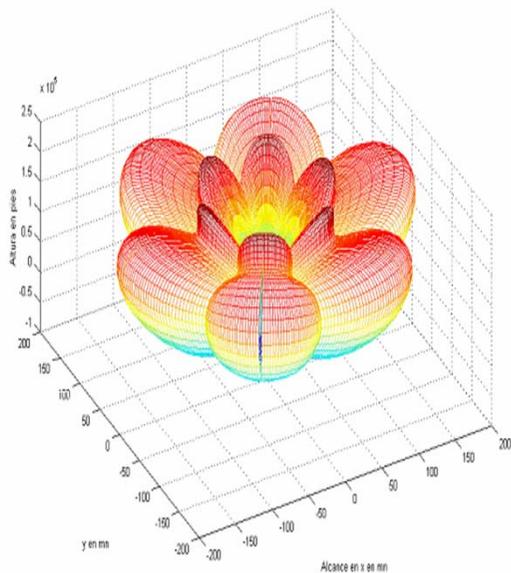
INDRA ADS-B HIGHLIGHTS  
**HIGHLIGHTS**



# VALIDATION OF ADS-B DATA

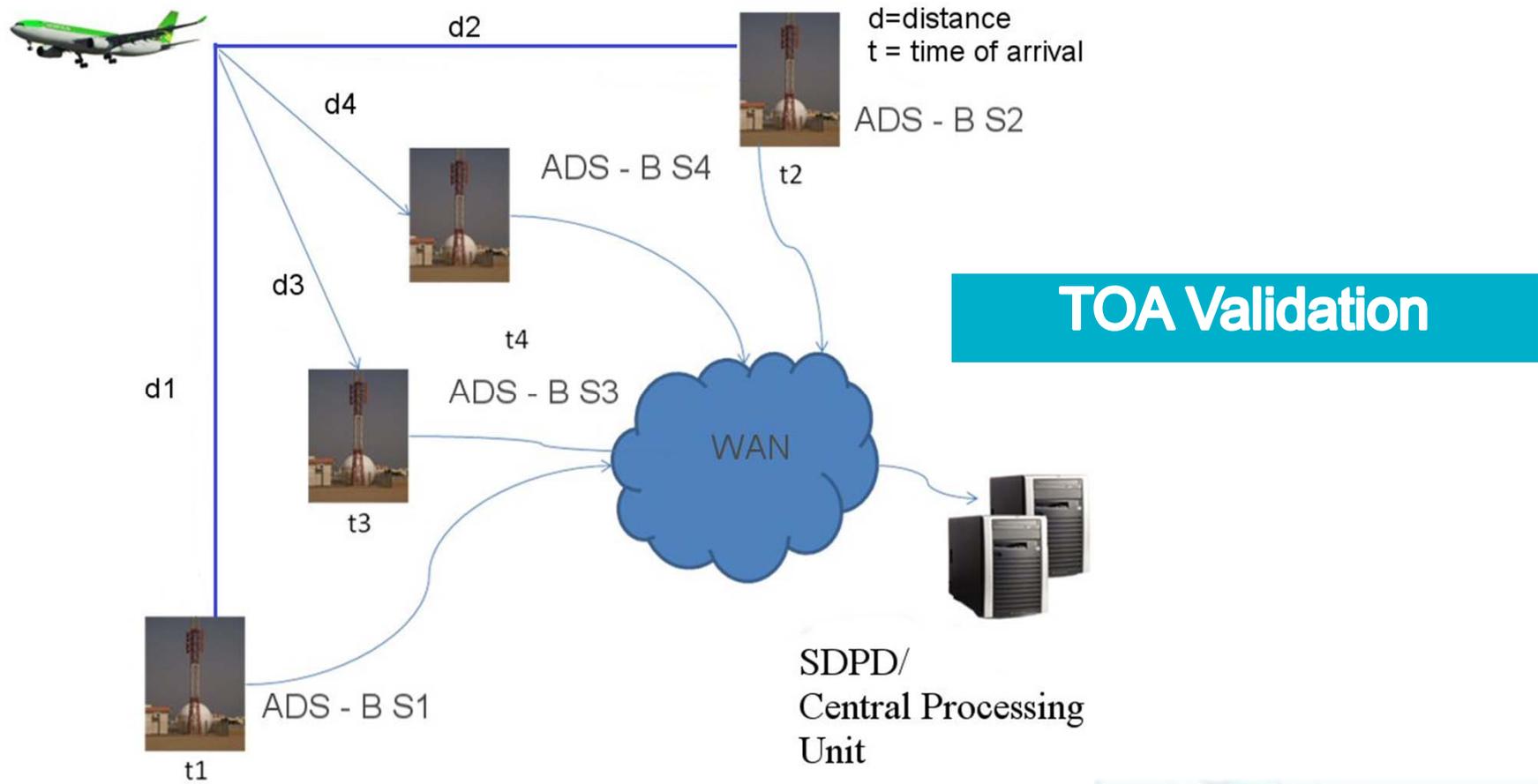
Indra ADS-B System provides 4 validation methods:

- 1. Angle of arrival validation:** The **sectorized antenna** of Indra's ADS-B System allows the determination of the direction or sector of arrival of the received messages, **this direction is correlated with the angle of arrival obtained from the position reported by the aircraft.**



# VALIDATION OF ADS-B DATA

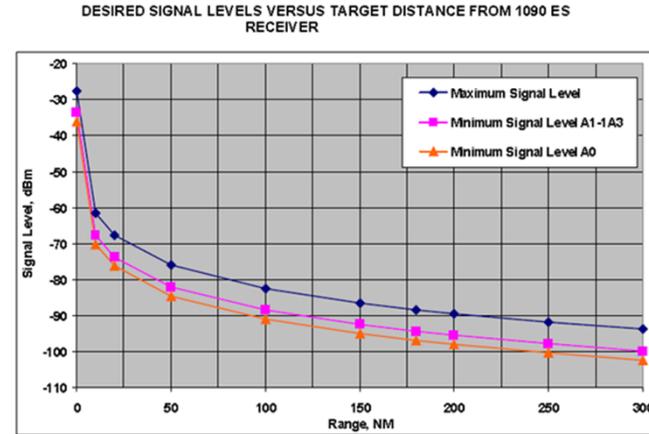
**2. Time of arrival (TOA) validation:** The principle of this validation method lies in the correlation between of Time of Arrival of Extended Squitters and the reported distance from multiple receivers.



## VALIDATION OF ADS-B DATA

### 3. Power measure versus range:

Depending on the type of transponder of the target and other parameters such as the antenna gain, height, distance, **Indra ADS-B system will expect to receive ES messages from a target that will be inside a range of power values.**



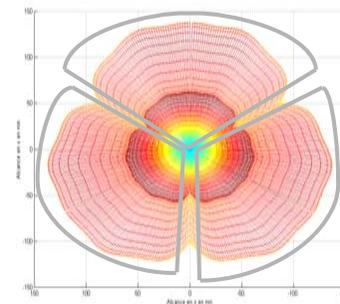
### 4. Target velocity against the ADS-B received target position change:

Actual and historic position and velocity information of the same target are also used to cross-check the credibility of both data items.

These validation methods have been developed and tested in SESAR program.

## MULTICHANNEL RECEIVER

- 1. Indra Multichannel Receiver offers the capability of using a 3 sectors antenna:** Sectorized antennas are **easy to install since they do not need to be sited at the top of towers and admit other elements located in parallel.** On the other hand, omnidirectional antennas shall be installed with no other obstacles in parallel, which could be impossible on many occasions (i.e: Installation of ADS-B in a tower where existing radar is already installed at the top). **Reduces multipath and reflections.**
- 2. Reduces the noise and increase the range:** Field-tested range beyond 300NM.
- 3. Possibility of using omni-directional antenna.**



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## SYSTEM DESIGN

# ADS-B RECEIVER

## Upgrades & Improvements:

- Higher sensitivity. 3 dB more than previous version. Better than -90dBm. (Range increased)
- ADS-B data validation methods
- Dual power supply
- Dual storage (RAID 2 Hard Drives Hot Swap)
- Automatic re-start after power outage
- Increase processing capability (600 targets)
- New graphical CMS integrated

## Features:

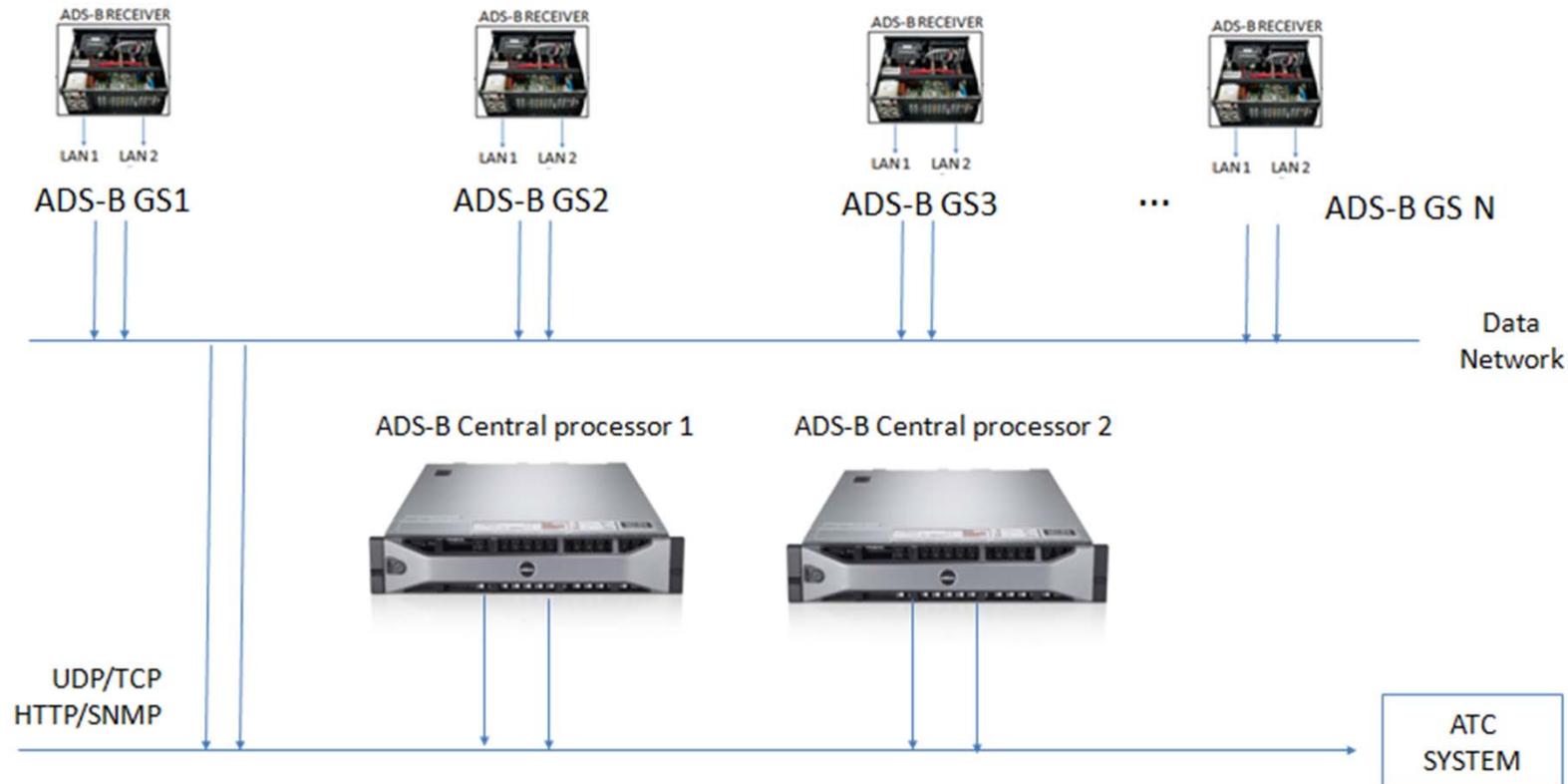
- Three (3) 1090 receivers inside
- Dual network interface
- Difference sizes & configurations
  - Rack mountable 19" or compact
  - Indoor/Outdoor



## SYSTEM DESIGN

# ADS-B CENTRAL PROCESSOR

- Used on ADS-B Networks with several receivers
- Only one interface with ATC System.
- **Fuses ADS-B data from up to 64 Ground Stations.**



## ADS-B CENTRAL PROCESSOR

- **ADS-B Data Validation using TOA of several GSS**
- Accept different versions of Asterix 21 as an input and output the required Asterix 21 version to ATC System
- Processing Capacity for more than 2000 targets
- **Data filtering:**
  - By ICAO address
  - Using Asterix 023 and 247 information
  - By Quality indicators and FOM
  - By Altitude
  - By Area/Sector.
- LCMS integrated



# CONTROL AND MONITORING SYSTEM

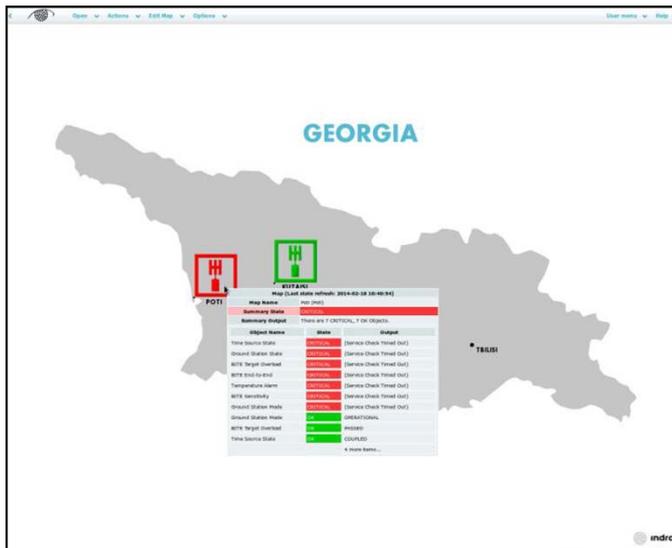
- Supervision of the status of each LRU
- Supervision of operating parameters
- Reports and alarms management
- Secure Access
- Control of operational parameters
- **Statistic analysis and historic values**
- SNMP and WEB



## SYSTEM DESIGN

# CONTROL AND MONITORING SYSTEM

- Supervision of each Ground Station
- Location of Ground Stations in map
- Monitoring and control of parameters

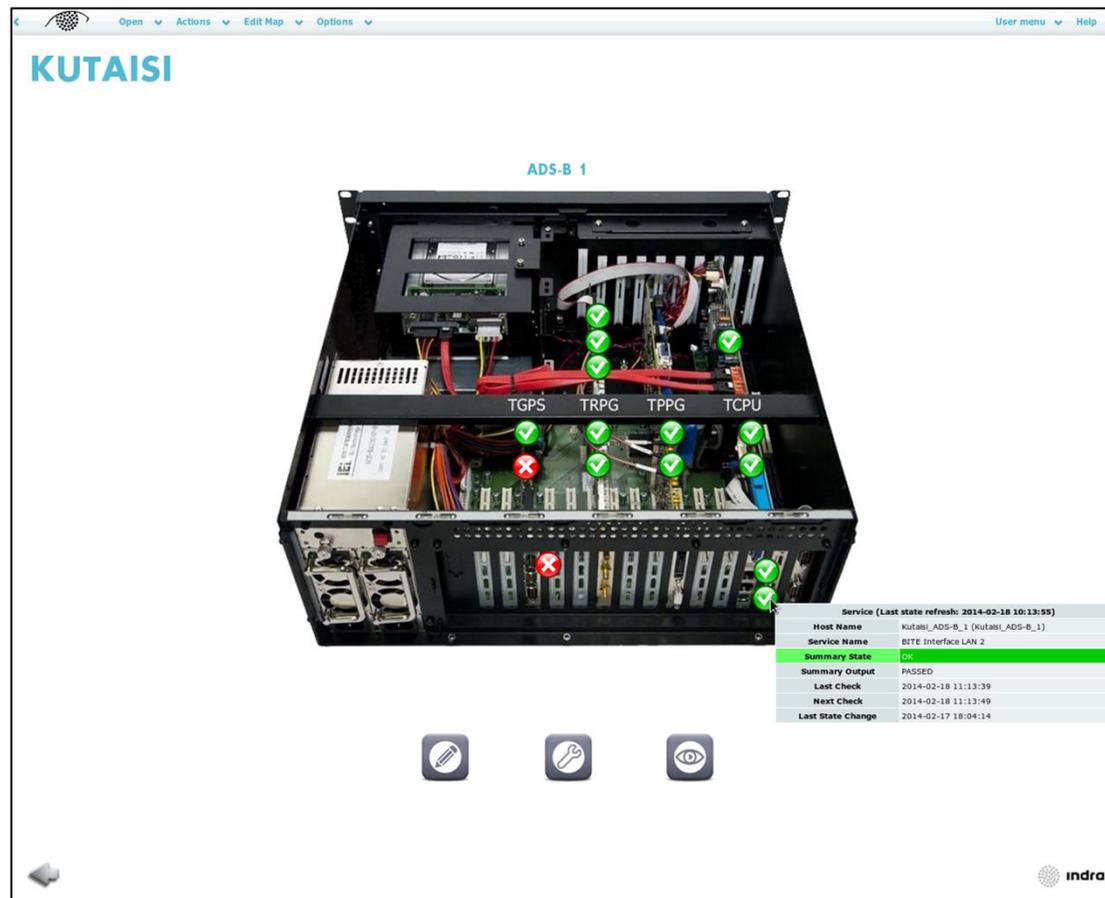


Host	Service	Status	Last Check	Duration	Attempt	Status Information
KUTAISI_ADS_B_1	BITE Buffer Overload	OK	02-18-2014 11:49:00	02:20h:18m:36s	1/1	PASSED
	BITE CPU Overload	OK	02-18-2014 11:49:00	02:20h:18m:36s	1/1	PASSED
	BITE End-to-End	OK	02-18-2014 11:49:00	02:20h:20m:52s	1/1	PASSED
	BITE Interface LAN 1	OK	02-18-2014 11:49:00	02:18h:42m:17s	1/1	PASSED
	BITE Interface LAN 2	OK	02-18-2014 11:49:00	02:18h:42m:17s	1/1	PASSED
	BITE Network Overload	OK	02-18-2014 11:49:00	02:20h:18m:36s	1/1	PASSED
	BITE Security	OK	02-18-2014 11:49:00	02:20h:18m:36s	1/1	PASSED
	BITE Target Overload	OK	02-18-2014 11:49:00	02:20h:18m:36s	1/1	PASSED
	General Canal 1 TRPO BITE	OK	02-18-2014 11:49:00	02:20h:18m:40s	1/1	PASSED
	General Canal 2 TRPO BITE	OK	02-18-2014 11:49:00	02:20h:18m:36s	1/1	PASSED
	General TRPO BITE	OK	02-18-2014 11:49:00	02:20h:18m:40s	1/1	PASSED
	General TRPO BITE	OK	02-18-2014 11:49:00	02:20h:18m:36s	1/1	PASSED
	General TRPO BITE	OK	02-18-2014 11:49:00	02:20h:18m:36s	1/1	PASSED
	General TRPO BITE	OK	02-18-2014 11:49:00	02:20h:18m:36s	1/1	PASSED
Ground Station Mode	WARNING	02-18-2014 11:49:00	02:02h:36m:32s	1/5	MAINTENANCE	
Ground Station Mode	WARNING	02-18-2014 11:49:00	02:02h:36m:32s	1/5	MAINTENANCE	
Status of GPS Antenna	CRITICAL	02-18-2014 11:49:00	02:17h:3m:37s	1/1	NOT CONNECTED	
Status of Time Synchronization	CRITICAL	02-18-2014 11:49:00	02:17h:3m:37s	5/5	NOT SYNCHRONIZED	
TRPO Device Status	OK	02-18-2014 11:49:00	02:20h:18m:36s	1/1	PASSED	
Temperature Alarm	OK	02-18-2014 11:49:00	02:20h:18m:42s	1/5	PASSED	
Time Source Mode	CRITICAL	02-18-2014 11:49:00	02:06h:15m:17s	5/5	NOT COUPLED	
KUTAISI_ADS_B_2	BITE Buffer Overload	OK	02-18-2014 11:49:00	02:19h:46m:53s	1/1	PASSED
	BITE CPU Overload	OK	02-18-2014 11:49:00	02:19h:46m:42s	1/1	PASSED
	BITE End-to-End	CRITICAL	02-18-2014 11:49:00	02:19h:12m:32s	1/1	FAILED
	BITE Interface LAN 1	OK	02-18-2014 11:49:00	02:19h:42m:17s	1/1	PASSED
	BITE Interface LAN 2	OK	02-18-2014 11:49:00	02:19h:46m:57s	1/1	PASSED
	BITE Network Overload	OK	02-18-2014 11:49:00	02:19h:46m:42s	1/1	PASSED
	BITE Security	CRITICAL	02-18-2014 11:49:00	02:02h:36m:32s	1/1	FAILED
	BITE Target Overload	OK	02-18-2014 11:49:00	02:19h:46m:53s	1/1	PASSED
	General Canal 1 TRPO BITE	OK	02-18-2014 11:49:00	02:19h:46m:53s	1/1	PASSED
	General Canal 2 TRPO BITE	OK	02-18-2014 11:49:00	02:19h:46m:53s	1/1	PASSED
	General TRPO BITE	OK	02-18-2014 11:49:00	02:19h:46m:53s	1/1	PASSED
	General TRPO BITE	OK	02-18-2014 11:49:00	02:19h:46m:53s	1/1	PASSED
	General TRPO BITE	OK	02-18-2014 11:49:00	02:19h:46m:42s	1/1	PASSED
	General TRPO BITE	OK	02-18-2014 11:49:00	02:19h:46m:53s	1/1	PASSED
Ground Station Mode	WARNING	02-18-2014 11:49:00	02:02h:11m:12s	1/5	MAINTENANCE	
Ground Station Mode	CRITICAL	02-18-2014 11:49:00	18:11:48m:26s	5/5	FAILED	
Status of GPS Antenna	OK	02-18-2014 11:49:00	02:19h:46m:42s	1/1	CONNECTED	
Status of Time Synchronization	CRITICAL	02-18-2014 11:49:00	18:11:48m:26s	5/5	NOT SYNCHRONIZED	
TRPO Device Status	OK	02-18-2014 11:49:00	02:19h:46m:57s	1/1	PASSED	
Temperature Alarm	OK	02-18-2014 11:49:00	02:19h:46m:42s	1/5	PASSED	
Time Source Mode	CRITICAL	02-18-2014 11:49:00	02:19h:46m:17s	5/5	NOT COUPLED	
PDI_ADS_B_1	BITE Buffer Overload	CRITICAL	02-18-2014 11:49:49	02:31h:19m:17s	1/1	(Service Check Timeout)
	BITE CPU Overload	CRITICAL	02-18-2014 11:49:49	02:31h:19m:17s	1/1	(Service Check Timeout)

## SYSTEM DESIGN

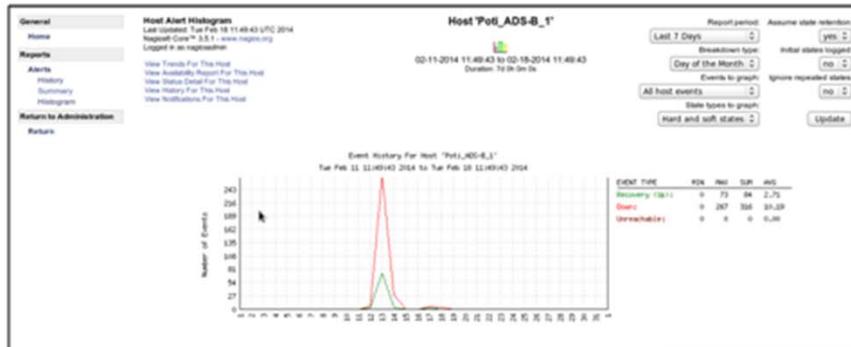
# CONTROL AND MONITORING SYSTEM

- Supervision of the status of each LRU
- Friendly interface with visual location of each LRU



# CONTROL AND MONITORING SYSTEM

- Statistical analyses and historical average values:



**Current Network Status**  
 Last Updated: Tue Feb 11 11:49:21 UTC 2014  
 Updated every 10 seconds  
 Nagios Core™ 3.5.1 - www.nagios.org  
 Logged in as nagiosadmin

**Host Status Totals**  
 Up: 3, Down: 1, Unreachable: 0, Pending: 0

**Service Status Totals**  
 OK: 4, Warning: 4, Unknown: 0, Critical: 0, Pending: 0

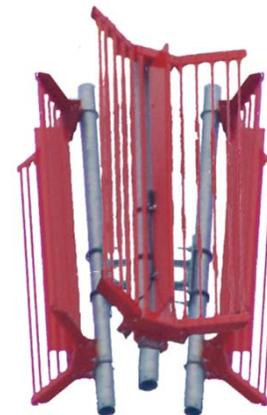
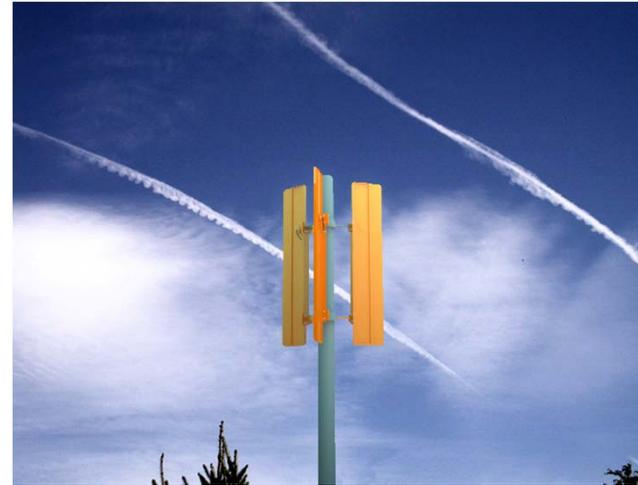
**Service Status Details For All Hosts**

Host	Service	Status	Last Check	Duration	Average	Status Information
Pot_ADS_B_1	BITE Buffer Overload	OK	02-11-2014 11:49:00	00:20:18:36	5/1	PASSED
Pot_ADS_B_1	BITE CPU Overload	OK	02-11-2014 11:49:00	00:20:18:36	5/1	PASSED
Pot_ADS_B_1	BITE End-to-End	OK	02-11-2014 11:49:00	00:20:25:52	5/1	PASSED
Pot_ADS_B_1	BITE Interface LAN 1	OK	02-11-2014 11:49:00	00:18:42:17	5/1	PASSED
Pot_ADS_B_1	BITE Interface LAN 2	OK	02-11-2014 11:49:00	00:18:45:7	5/1	PASSED
Pot_ADS_B_1	BITE Network Overload	OK	02-11-2014 11:49:00	00:20:18:36	5/1	PASSED
Pot_ADS_B_1	BITE Sensibility	OK	02-11-2014 11:49:00	00:20:18:36	5/1	PASSED
Pot_ADS_B_1	BITE Target Overload	OK	02-11-2014 11:49:00	00:20:18:36	5/1	PASSED
Pot_ADS_B_1	General Canal 1 TRPG-BITE	OK	02-11-2014 11:49:00	00:20:18:36	5/1	PASSED
Pot_ADS_B_1	General Canal 2 TRPG-BITE	OK	02-11-2014 11:49:00	00:20:18:36	5/1	PASSED
Pot_ADS_B_1	General Canal 3 TRPG-BITE	OK	02-11-2014 11:49:00	00:20:18:40	5/1	PASSED
Pot_ADS_B_1	General TRPG-BITE	OK	02-11-2014 11:49:00	00:20:18:40	5/1	PASSED
Pot_ADS_B_1	General TRPG-BITE	OK	02-11-2014 11:49:00	00:20:18:36	5/1	PASSED
Pot_ADS_B_1	General TRPG-BITE	OK	02-11-2014 11:49:00	00:20:18:36	5/1	PASSED
Pot_ADS_B_1	Ground Station Mode	WARNING	02-11-2014 11:49:00	00:20:18:32	5/5	MAINTENANCE
Pot_ADS_B_1	Status of GPS Antenna	CRITICAL	02-11-2014 11:49:00	00:20:18:17	5/5	FAILED
Pot_ADS_B_1	Status of GPS Antenna	CRITICAL	02-11-2014 11:49:00	00:17:50:37	5/1	NOT CONNECTED
Pot_ADS_B_1	Status of Time Synchronization	CRITICAL	02-11-2014 11:49:00	00:17:50:37	5/5	NOT SYNCHRONIZED
Pot_ADS_B_1	TRPG Device Status	OK	02-11-2014 11:49:00	00:20:18:36	5/1	PASSED
Pot_ADS_B_1	Temperature Alarm	OK	02-11-2014 11:49:00	00:20:18:40	5/5	PASSED
Pot_ADS_B_1	Time Source Status	CRITICAL	02-11-2014 11:49:00	00:20:18:17	5/5	NOT COUPLED
Pot_ADS_B_2	BITE Buffer Overload	OK	02-11-2014 11:49:00	00:19:46:53	5/1	PASSED
Pot_ADS_B_2	BITE CPU Overload	OK	02-11-2014 11:49:00	00:19:46:43	5/1	PASSED
Pot_ADS_B_2	BITE End-to-End	CRITICAL	02-11-2014 11:49:00	00:19:52:52	5/1	FAILED
Pot_ADS_B_2	BITE Interface LAN 1	OK	02-11-2014 11:49:00	00:18:42:17	5/1	PASSED
Pot_ADS_B_2	BITE Interface LAN 2	OK	02-11-2014 11:49:00	00:18:44:57	5/1	PASSED
Pot_ADS_B_2	BITE Network Overload	OK	02-11-2014 11:49:00	00:19:46:43	5/1	PASSED
Pot_ADS_B_2	BITE Sensibility	CRITICAL	02-11-2014 11:49:00	00:19:52:52	5/1	FAILED
Pot_ADS_B_2	BITE Target Overload	OK	02-11-2014 11:49:00	00:19:46:53	5/1	PASSED
Pot_ADS_B_2	General Canal 1 TRPG-BITE	OK	02-11-2014 11:49:00	00:19:46:53	5/1	PASSED
Pot_ADS_B_2	General Canal 2 TRPG-BITE	OK	02-11-2014 11:49:00	00:19:46:53	5/1	PASSED
Pot_ADS_B_2	General Canal 3 TRPG-BITE	OK	02-11-2014 11:49:00	00:19:46:53	5/1	PASSED
Pot_ADS_B_2	General TRPG-BITE	WARNING	02-11-2014 11:49:00	00:19:46:53	5/1	WARNING
Pot_ADS_B_2	General TRPG-BITE	OK	02-11-2014 11:49:00	00:19:46:43	5/1	PASSED
Pot_ADS_B_2	General TRPG-BITE	OK	02-11-2014 11:49:00	00:19:46:53	5/1	PASSED
Pot_ADS_B_2	Ground Station Mode	WARNING	02-11-2014 11:49:00	00:20:18:32	5/5	MAINTENANCE
Pot_ADS_B_2	Status of GPS Antenna	CRITICAL	02-11-2014 11:49:00	14:16:46:31	5/5	FAILED
Pot_ADS_B_2	Status of GPS Antenna	OK	02-11-2014 11:49:00	00:19:46:43	5/1	CONNECTED
Pot_ADS_B_2	Status of Time Synchronization	CRITICAL	02-11-2014 11:49:00	14:16:46:31	5/5	NOT SYNCHRONIZED
Pot_ADS_B_2	TRPG Device Status	OK	02-11-2014 11:49:00	00:19:46:53	5/1	PASSED
Pot_ADS_B_2	Temperature Alarm	OK	02-11-2014 11:49:00	00:19:46:43	5/5	PASSED
Pot_ADS_B_2	Time Source Status	CRITICAL	02-11-2014 11:49:00	00:18:50:17	5/5	NOT COUPLED
Pot_ADS_B_1	BITE Buffer Overload	CRITICAL	02-11-2014 11:49:49	00:30:18:17	5/1	(Service Check Traced Out)
Pot_ADS_B_1	BITE CPU Overload	CRITICAL	02-11-2014 11:49:49	00:30:18:17	5/1	(Service Check Traced Out)
Pot_ADS_B_1	BITE End-to-End	CRITICAL	02-11-2014 11:49:49	00:30:18:17	5/1	(Service Check Traced Out)

## SYSTEM DESIGN

# ANTENNAS

- The Antenna Subsystem is composed of:
  - Three Sectorized antennas or
  - One Omni-directional antenna
  - RF Filters
  - Mast head box with LNA (Optional)
- Antenna columns are directional. Each column covers a minimum of 120°. This increases the range and reduces the noise received at each channel.
- Antenna Gain Options:
  - 12 dB for Long Range
  - 9 dB for Medium- Long Range
  - 5 dB Medium Range
  - 2 dB Airport Surveillance
- Options & Upgrades: Solar Panel , Diesel Generator and batteries for Outdoor.



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# EXPERIENCE

- More than 8 years of ADS-B experience.

Country	Units	Customer
Morocco	6 (3x2) ADS-B	ONDA
Peru	2 (1x2) ADS-B	CORPAC
Barranquilla (Colombia)	20 (10x2) ADS-B	ACC
Libia (Tripoli and Benghazi)	4 (2x2)	LCAA
Mongolia	5 (5x1) ADS-B	MCAA
Georgia	4 (2x2) ADS-B	SAKAERONAVIGATSIA
France	1 (1X1) ADS-B	EUROCONTROL
Switzerland	2 (1x2) ADS-B	RUAG
Tegucigalpa (Honduras)	1 ADS-B	COCESNA
Turkey	2 (1X2) ADS-B	DHMI
Pakistan	1 ADS-B	PCAA
Colombia (Río Negro)	1 ADS-B	ACC
Barcelona (Spain)	32 (ADS-B +MLAT)	AENA
Vilnius (Lithuania)	11 (ADS-B +MLAT)	ORO NAVIGACIJA
Bogota (Colombia)	26 (ADS-B +MLAT)	ACC



# Thank you

**Indra**  
Air Traffic

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F +34 91 480 50 80  
[www.indracompany.com](http://www.indracompany.com)